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RELEASES OF RECENTLY IMPORTED LARCH CASEBEARER PARASITES FOR BIOLOGICAL CONTROL IN THE WESTERN UNITED STATES, INCLUDING RELOCATIONS OF *AGATHIS PUMILA*

by

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ABSTRACT

Releases of *Chrysocharis laricinellae, Dicladocerus westwoodii, Dicladocerus japonicus, Elachertus argissa, Necremnus metalarus,* (all, Hymenoptera: Eulophidae), and *Agathis pumila* (Hymenoptera: Braconidae), for biological control of the larch casebearer in Washington, Oregon, Idaho, and Montana included some newly imported stocks and additional release locations.

Keywords: Parasites (insect) (-forest pest control, larch casebearer, biological control (-forest pests.

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INTRODUCTION

The larch casebearer, *Coleophora laricella* (Hbn.), is an introduced pest of western larch, *Larix occidentalis* Nutt. Since its discovery near St. Maries, Idaho, in 1957 (Denton 1958), this insect has caused repeated defoliation in some areas of northern Idaho, resulting in serious branch dieback and reductions in radial increment of up to 90 percent (Tunnock et al. 1969). The larch casebearer is now found over much of the distribution of western larch in Idaho, Montana, northeastern Washington, and southern British Columbia. The infestation is still spreading and intensifying in the Blue Mountains of Oregon and in the Cascade Range of Washington.

A biological control program of parasite introductions was initiated in 1960 in an effort to combat this pest. About 2,400 adults of the European parasite, *Agathis pumila* (Ratz.), were reared from an earlier establishment site in Rhode Island and shipped to Idaho where they were released on five sites (Denton 1972). The parasite was obviously adapted to at least some localities in the West, because it was recovered on the release plots in 1962 and 1963. Region 1 entomologists imported and released a new supply of *A. pumila* to aid in its spread throughout the growing range of the casebearer. In 1964 and 1965, infested larch branches from Vermont and Massachusetts were set up for rearing *A. pumila* in a large outdoor cage in Sandpoint, Idaho, where emerging *A. pumila* were collected and transferred into other cages containing locally derived host stock (Denton, personal communication). Branches from these latter cages, bearing overwintering, parasitized larvae, were transferred to about 375 sites throughout the infested zone. Bousfield et al. (1974) reported sampling 173 of the *A. pumila* release sites and finding *A. pumila* established at about half the sites.

Effectiveness of *A. pumila* has varied widely at the locations where it has become established. Our best long-term evaluation of its performance under western conditions is at the five original release sites. Parasitization on three of those rose to the 40- to 60-percent range over the period 1960-70 and apparently was responsible for significant reductions in densities of larch casebearer (Denton 1972). At the other two original release sites, however, *A. pumila*, although persisting, was building up at a much slower rate. *A. pumila* appears to suffer considerable mortality in the teneral adult stage before it emerges from the host case under conditions of low relative humidity, which may help explain the difference in its performance between sites.

In recent years, we have expanded our parasite introduction program to include other species to supplement the action of *A. pumila*, starting with the release of *Chrysocharis laricinellae* (Ratz.) and *Dicladocerus westwoodii* Westw. in 1972 (Ryan and Denton 1973). In 1974, four other species were released: *Necremnus metalarus* (Walk.), *Elachertus argissa* (Walk.), *Dicladocerus japonicus* Yoshimoto,[1] and *Diadegma laricinella* (Strobl) (Ryan et al. 1975). In 1975 and 1976 we released additional numbers of some of these species on new sites and on some old sites. The purpose of this paper is to document these additional releases.

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[1] This species was previously referred to as *Dicladocerus* "A" (Ryan et al. 1975) but was recently described by Yoshimoto (1976).

ACQUISITION, IDENTITY, AND RELEASE OF PARASITES

Details of the releases are summarized in table 1. Many of the releases reported here were from laboratory cultures derived from sources previously reported (Ryan et al. 1975). Sources are identifiable from the footnotes in table 1. Collections were made for several consecutive years in central Europe and in Japan. As this new genetic material became available, it was incorporated into the laboratory cultures to help offset any genetic deterioration unavoidably associated with laboratory propagation (Mackauer 1976).

A significant new collection was some additional *Dicladocerus japonicus* from a more northerly latitude, Shintoku and Shikoai, Hokkaido, Japan, by Dr. Paul Schaefer of the Asian Parasite Laboratory. Also, additional genetic stock of *Agathis pumila* obtained from Wisconsin was released, as was additional *A. pumila* material directly from Europe. Previously, all *A. pumila* material released in the Western United States was from stock already established in the Northeastern States. Many of the *A. pumila* released in the newer infestations in Oregon were, however, adults reared from previous colonization sites in Idaho and Montana.

Incoming exotic material was received at the Beneficial Insect Research Laboratory Quarantine facility at Newark, Delaware. Identifications were made by Drs. Gordon Gordh and P. M. Marsh of the U.S. National Museum.

Table 1--Releases of *Elachertus argissa*, *Necremnus metalarus*, *Chrysocharis laricinellae*, *Dicladocerus westwoodii*, and *Dicladocerus japonicus* in Idaho, Montana, Washington, and Oregon, 1975-76, and *Agathis pumila*, 1971-76

Locality	Date of release	Number released		
		Male	Female	Total
Elachertus argissa (Walker)[1] (Hymenoptera: Eulophidae)				
Idaho:				
Bob's Creek and Potlatch Creek	June 11, 1975	87	616	703
46°51'N 116°20'W, T41N R1E S33				
Meadow Creek	June 11, 1975	111	616	727
46°36'N 115°55'W, T38N R4E S11				
Felton Creek	June 20, 1975	84	616	700
46°48'N 116°50'W, T40N R4W S20	Sept. 30, 1976	3	5	8
1 km N Troy Reservoir	June 20, 1975	50	200	250
46°49'N 116°47'W, T40N R4W S14				
Four Corners	May 21, 1976	30	123	153
48°17'N 116°59'W, T57N R5W S17				
Squaw Valley	May 21, 1976	25	124	149
48°27'N 116°56'W, T59N R5W S14	Sept. 23, 1976	19	34	53
Hanna Flats, 1 km W Priest Lake Ranger Stn.	May 21, 1976	30	123	153
48°34'N 116°56'W, T60N R5W S10				
Montana:				
6 km N Evaro	May 30, 1975	36	365	401
47°05'N 114°04'W, T15N R20W S1	Sept. 27, 1976	11	34	45
Washington:				
Colville Indian Reservation, E Round Lake	May 28, 1975	35	357	392
48°17'N 118°18'W, T32N R36E S8	Sept. 21, 1976	21	34	55
Charley Creek, 26 km S Pomeroy	May 29, 1975	42	358	400
46°15'N 117°30'W, T9N R42E S24				
Oregon:				
20 km N Elgin (BCC plot 6[2])	May 28, 1975	11	105	116
45°44'N 117°55'W, T3N R39E S15	Oct. 9, 1975	18	197	215
	Oct. 10, 1975	21	125	146
	Oct. 15, 1975	32	153	185
22 km NNE Elgin (BCC plot 5)	May 28, 1975	11	101	112
45°45'N 117°50'W, T3N R40E S9	Sept. 18, 1975	11	21	32
	Sept. 23, 1976	21	41	62
25 km NE Elgin (BCC plot 4)	May 28, 1975	7	88	95
45°42'N 117°40'W, T3N R41E S35				
14 km SE Elgin (BCC plot 10)	Sept. 9, 1975	6	79	85
45°30'N 117°47'W, T1S R40E S11				
13 km SE Elgin (BCC plot 9)	Sept. 9, 1975	9	84	93
45°29'N 117°50'W, T1S R40E S17				
12 km SSE Elgin (BCC plot 8)	Sept. 9, 1975	11	76	87
45°28'N 117°51'W, T1S R40E S19				
15 km SSE Elgin (BCC plot 7)	Sept. 9, 1975	10	79	89
45°26'N 117°52'W, T1S R39E S36				
Necremnus metalarus (Walker)[1] (Hymenoptera: Eulophidae)				
Idaho:				
Bob's Creek and Potlatch Creek	June 11, 1975	1	53	54
46°51'N 116°20'W, T41N R1E S33	Sept. 25, 1975	7	487	494
Meadow Creek	June 11, 1975	0	58	58
46°36'N 115°55'W, T38N R4E S11	Sept. 26, 1975	14	485	499

See footnotes at end of table.

Continued

Table 1--Releases of *Elachertus argissa, Necremnus metalarus, Chrysocharis laricinellae, Dicladocerus westwoodii,* and *Dicladocerus japonicus* in Idaho, Montana, Washington, and Oregon, 1975-76, and *Agathis pumila,* 1971-76--*Continued*

Locality	Date of release	Number released		
		Male	Female	Total
Idaho (continued):				
Felton Creek	June 20, 1975	0	54	54
46°48'N 116°50'W, T40N R4W S20	Sept. 25, 1975	11	487	498
	Sept. 30, 1976	28	48	76
Hanna Flats, 1 km W Priest Lake Ranger Stn.	Oct. 2, 1975	7	465	472
48°34'N 116°56'W, T60N R5W S10	May 21, 1976	1	32	33
Squaw Valley	Oct. 2, 1975	19	465	484
48°27'N 116°56'W, T59N R5W S14	May 21, 1976	3	33	36
	Sept. 23, 1976	2	30	32
Four Corners	Oct. 2, 1975	11	510	521
48°17'N 116°59'W, T57N R5W S17	May 21, 1976	2	33	35
Montana:				
6 km N Evaro	Sept. 26, 1975	2	363	365
47°05'N 114°04'W, T15N R20W S1	Sept. 27, 1976	2	33	35
Washington:				
Colville Indian Reservation, E Round Lake	Sept. 24, 1975	2	326	328
48°17'N 118°18'W, T32N R36E S8	Sept. 21, 1976	1	33	34
Charley Creek, 26 km S Pomeroy	Sept. 30, 1975	8	564	572
46°15'N 117°30'W, T9N R42E S24				
Oregon:				
20 km N Elgin (BCC plot 6)	May 28, 1975	2	36	38
45°45'N 117°55'W, T3N R39E S15	Oct. 9, 1975	0	331	331
	Oct. 10, 1975	0	56	56
	Oct. 15, 1975	0	76	76
22 km NNE Elgin (BCC plot 5)	May 28, 1975	3	36	39
45°45'N 117°50'W, T3N R40E S9	Sept. 18, 1975	3	124	127
	Sept. 23, 1975	2	307	309
	Sept. 29, 1975	9	521	530
	Oct. 2, 1975	18	873	891
	May 30, 1976	0	42	42
	Sept. 23, 1976	27	50	77
25 km NE Elgin (BCC plot 4)	May 28, 1975	6	34	40
45°42'N 117°40'W, T3N R41E S35				
14 km SE Elgin (BCC plot 10)	Sept. 9, 1975	5	64	69
45°30'N 117°47'W, T1S R40E S11				
13 km SE Elgin (BCC plot 9)	Sept. 9, 1975	7	57	64
45°29'N 117°50'W, T1S R40E S17				
12 km SSE Elgin (BCC plot 8)	Sept. 9, 1975	10	58	68
45°28'N 117°51'W, T1S R40E S19				
15 km SSE Elgin (BCC plot 7)	Sept. 9, 1975	7	59	66
45°26'N 117°52'W, T1S R39E S36				
Chrysocharis laricinellae (Ratz.) (Hymenoptera: Eulophidae)				
Idaho:[1/]				
Four Corners	Sept. 23, 1976	85	26	111
48°17'N 116°59'W, T57N R5W S17				
Squaw Valley	Sept. 23, 1976	85	26	111
48°27'N 116°56'W, T59N R5W S14				

See footnotes at end of table.

Continued

Table 1--Releases of *Elachertus argissa, Necremnus metalarus, Chrysocharis laricinellae, Dicladocerus westwoodii,* and *Dicladocerus japonicus* in Idaho, Montana, Washington, and Oregon, 1975-76, and *Agathis pumila,* 1971-76--*Continued*

Locality	Date of release	Number released		
		Male	Female	Total
Idaho (continued):				
Hanna Flats, 1 km W Priest Lake Ranger Stn.	Sept. 23, 1976	85	26	111
48°34'N 116°56'W, T60N R5W S10				
Felton Creek	Sept. 30, 1976	200	74	274
46°48'N 116°50'W, T40N R4W S20				
Oregon:[3]				
26 km NE Elgin (BCC plot 3)	May 28, 1975	491	307	798
45°42'N 117°39'W, T3N R41E S35	June 4, 1975	524	488	1012
	Sept. 23, 1975	284	124	408
22 km NNE Elgin (BCC plot 5)	May 19, 1976	368	328	696
45°45'N 117°50'W, T3N R40E S9	Sept. 23, 1976	342	145	487
	Sept. 29, 1976	393	74	467
	Oct. 7, 1976	268	69	337
Dicladocerus westwoodii Westw.[1] (Hymenoptera: Eulophidae)				
Idaho:				
Benton Creek, Priest River Exp. For.	May 20, 1976	117	46	163
48°21'N 116°50'W, T58N R4W S26	Sept. 22, 1976	105	39	144
	Oct. 8, 1976	278	155	433
Dicladocerus japonicus Yoshimoto[4] (Hymenoptera: Eulophidae)				
Idaho:				
1 km N Troy Reservoir	June 20, 1975	258	285	543
46°49'N 116°48'W, T40N R4W S14				
Four Corners	May 21, 1976	52	40	92
48°17'N 116°59'W, T57N R5W S17				
Hanna Flats, 1 km W Priest Lake Ranger Stn.	May 21, 1976	52	40	92
48°34'N 116°56'W, T60N R5W S10				
Squaw Valley	May 21, 1976	53	41	94
48°27'N 116°56'W, T59N R5W S14				
Moscow Mt., 7 km N Troy	June 4, 1976	34	54	88
46°47'N 116°48'W, T40N R4W S23				
Oregon:				
22 km NNE Elgin (BCC plot 5)	May 30, 1976	78	102	180
45°45'N 117°50'W, T3N R40E S9	Sept. 23, 1976	72	280	352
	Oct. 7, 1976	237	146	383
Agathis pumila (Ratz.) (Hymenoptera: Braconidae)				
Washington:				
Charley Creek, 26 km S Pomeroy	July 10, 1971[5]	73	14	87
46°15'N 117°30'W, T9N R42E S24	July 19, 1971[5]	31	122	153
	July 7, 1973 [1]	91	111	202
	July 7, 1973 [6]	131	222	353
Oregon:				
Emigrant Springs, 27 km ESE Pendleton[5]	July 12, 1971	85	14	99
45°33'N 118°28'W, T1N R35E S20	July 19, 1971	38	113	151
	July 20, 1972	30	38	68
	July 14, 1973	341	333	674
	July 20, 1973	10	106	116

See footnotes at end of table.

Continued

Table 1--Releases of *Elachertus argissa, Necremnus metalarus, Chrysocharis laricinellae, Dicladocerus westwoodii,* and *Dicladocerus japonicus* in Idaho, Montana, Washington, and Oregon, 1975-76, and *Agathis pumila,* 1971-76--*Continued*

Locality	Date of release	Number released		
		Male	Female	Total
Oregon (continued):				
Hwy 204, 14 km E Weston 45°48'N 118°14'W, T4N R37E S30	Aug. 20, 1974[6]	34	21	55
	Aug. 28, 1974[6]	10	7	17
	July 7, 1975[1]	340	222	562
	July 14, 1975[1]	11	74	85
26 km NE Elgin (BCC plot 3)[5] 45°42'N 117°39'W, T3N R41E S35	Aug. 20, 1975	24	300	324
	Aug. 25, 1975	6	300	306
25 km NE Elgin (BCC plot 4)[5] 45°42'N 117°40'W, T3N R41E S35	Aug. 20, 1975	24	300	324
	Aug. 25, 1975	8	400	408
22 km NNE Elgin (BCC plot 5) 45°45'N 117°50'W, T3N R40E S9	Aug. 20, 1975[5]	24	300	324
	Aug. 21, 1975[5]	15	300	315
	Aug. 25, 1975[5]	4	200	204
	July 6, 1976[1]	40	87	127
20 km N Elgin (BCC plot 6)[5] 45°44'N 117°55'W, T3N R39E S15	Aug. 21, 1975	15	300	315
	Aug. 25, 1975	6	300	306
15 km SSE Elgin (BCC plot 7)[5] 45°26'N 117°52'W, T1S R39E S36	July 29, 1975	66	141	207
	Aug. 21, 1975	24	300	324
	Aug. 22, 1975	6	300	306
	Aug. 26, 1975	1	200	201
	Aug. 27, 1975	0	4	4
12 km SSE Elgin (BCC plot 8)[5] 45°28'N 117°51W, T1S R40E S19	Aug. 15, 1975	100	100	200
	Aug. 20, 1975	24	300	324
	Aug. 22, 1975	6	300	306
	Aug. 26, 1975	0	100	100
	July 4, 1976	1	10	11
	July 6, 1976	30	30	60
	July 8, 1976	100	100	200
	July 12, 1976	20	80	100
	July 14, 1976	40	200	240
	July 19, 1976	0	106	106
13 km SE Elgin (BCC plot 9)[5] 45°29'N 117°50'W, T1S R40E S17	Aug. 20, 1975	24	300	324
	Aug. 22, 1975	6	300	306
	Aug. 26, 1975	2	100	102
	Aug. 28, 1975	0	52	52
	July 12, 1976	75	300	375
	July 16, 1976	10	122	132
14 km SE Elgin (BCC plot 10)[5] 45°30'N 117°47'W, T1S R40E S11	Aug. 20, 1975	24	300	324
	Aug. 21, 1975	15	300	315
	Aug. 22, 1975	6	300	306

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[1] Parasite strain originated in Austria-northern Italy.

[2] Boise Cascade Corp. plot number.

[3] Parasite strain originated in Sweden.

[4] Parasite strain originated in Japan.

[5] Parasite strain recolonized from Idaho-Montana.

[6] Parasite strain recolonized from Wisconsin.

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